

CONGRATULATIONS! You now own APPLIED ENGINEERING'S Z-80 card. Applied Engineering is a leading manufacturer of Apple peripherals. Because of the time and care taken in the design and manufacture of your Z-80 card, we are sure that you will enjoy the use of it for many years to come.

This manual was written with a Z-80 Plus card and Wordstar using an Apple IIe.

APPLE PERIPHERAL CARDS: WHAT GOES WHERE

Unlike Applesoft and Integer BASIC (but similar to Apple PASCAL) many programs that use the Z-80 card require that peripheral I/O cards be plugged into specific slots depending on their use. The peripheral card assignments for the Z-80 card are the same as for Apple Pascal so if your system is set up for Apple Pascal, no rearrangement is necessary. Please refer to Figure 1 below for the correct assignment of peripheral cards for the various Apple slots.

SLOT

- | | |
|---|--|
| 0 | RAM Card or Basic ROM (Apple IIe has no slot 0.) |
| 1 | Printer Interface |
| 2 | General Purpose I/O (Music Synthesizer, Modem, A/D, etc.) |
| 3 | 80 Column Card or G.P. I/O |
| 4 | Z-80 Plus Card or G.P. I/O |
| 5 | Z-80 Plus Card, Disks 3 and 4, or G.P. I/O |
| 6 | Disk Drive 1 and 2 (Must have at least one drive in Slot 6) |
| 7 | Timemaster Clock, Z-80 Plus Card, or G.P. I/O |

FIGURE 1

INSTALLING THE Z-80 PLUS CARD IN YOUR APPLE

The Z-80 Plus card simply plugs into a connector inside your Apple. Care must be exercised however, so follow these instructions exactly.

- 1) TURN OFF THE APPLE'S POWER SWITCH: This is very important to prevent damaging the computer as well as your Z-80 Plus card.
- 2) Remove the cover from the Apple. This is done by pulling up on the cover at the rear edge (the edge farthest from the keyboard) until the two corner fasteners pop apart. Then slide the cover up and backwards until it comes free.
- 3) Inside the Apple, across the rear of the main circuit board, there is a row of eight long narrow sockets called "slots". You can plug your Z-80 Plus into any slot except 0. (The Apple IIe has no slot 0.) Slot 5 is the preferred slot with slot 7 being preferred next after slot 5. Insert the fingers of the circuit board into the slot you want. The fingers will enter the slot with some friction and then seat firmly.
- 4) Carefully recheck your work and replace the Apple's cover by sliding the front edge into place. Then press down on the rear corners until they pop into place.

IMPORTANT: Always use a write protect tab on your CP/M disks until you become familiar with the system.

If you plan only to use CP/M and are not going to program in it then you need not read any further.

The Applied Engineering Z-80 Plus card has all the necessary hardware to interface a Z-80 microprocessor (contained on the card) to the Apple computer. The Applied Engineering Z-80 card permits the direct execution of 8080, 8085 and Z-80 programs, including Digital Research's CP/M operating system as well as all of the programs that execute in the CP/M software environment.

To start up in CP/M simply insert a CP/M disk in drive 1 (A) and turn your Apple on. The screen should now display....

A>

The ">" is your CP/M prompt. You can find out what files you have on the diskette in drive A by typing the DIR (directory) command. If you wish you can make a back-up copy of your disk by using the COPY program on the CP/M disk. If your disk is a 44K or 56K then you must first format a disk in drive B. To do this type ...

FORMAT B:=A: (return)

then type ...

COPY B:=A: (return)

If you have a 60K disk then you can skip the formatting step because it is built into the 60K system. So for a 60K disk type

COPY B:=A: (return)

When you want to run a CP/M file just type the name.

MAKING A COPY OF A FILE

The PIP command is used to perform the copy operations. PIP stands for "Peripheral Interchange Program." It is a program that you execute by typing "PIP". The PIP prompt is a "*". Simple PIP expressions take this form:

d:copyname=d:originalname

The "d" stands for the letter of the drive. As you can see, you can change the name of a file when you copy it if you wish. For example:

*B:WS.COM=A:WS.COM

Will copy Wordstar from drive A: to drive B:

For more information see the CP/M handbook by Rodney Zaks (Ref at the back of this manual).

REMEMBER... CP/M IS JUST A DOS, BY ITSELF IT DOES NOTHING!

ADDRESS BUS INTERFACE

The Z-80 Plus card address bus is interfaced to the Apple bus through a translation PROM. The PROM resolves the memory address conflicts that exist between the 6502 and the Z-80 microprocessor. This PROM shifts Z-80 interrupts and CP/M starting addresses out of the 6502 page of memory. In addition, the addresses in the range of \$C000-EFFF are shifted to allow continuous memory for CP/M. Please refer to Figure 3 below which shows exactly how the PROM translator works.

| Z-80 ADDRESS | APPLE ADDRESS |
|-----------------------|---------------|
| \$0000 - AFFF +\$1000 | \$1000 - BFFF |
| \$B000 - DFFF +\$2000 | \$D000 - FFFF |
| \$E000 - EFFF -\$2000 | \$C000 - CFFF |
| \$F000 - FFFF -\$F000 | \$0000 - 0FFF |

Please notice when a Ram card is installed in slot 0, the Z-80 Plus card can address continuous memory from \$0000 to \$DFFF, without accessing the 6502 zero page of memory or the Apple peripheral memory area.

WHY THE Z-80?

Your primary reason for having a Z-80 card in your Apple is so that you can run CP/M software in your computer. CP/M is an advanced DOS sold and marketed by various software producers under license by Digital Research, Inc. CP/M was the first microcomputer operating system. It is still the most widely supported one available. The wide support means more software choices for you as a user. You now have a choice of many sophisticated word processing, accounting, business and professional software packages when you have a Z-80 Plus card. Unlike standard Apple DOS, CP/M supports many languages in addition to Basic, including Fortran, Cobol, and Basic Compiler. CP/M has many conveniences not found in Apple DOS such as fast disk I/O, better interface to machine language programs, simpler file transfer and wild card file naming conventions that allow you to refer to multiple files with one name.

Your Applied Engineering Z-80 Plus card will run and operate with the CP/M offered by various software producers through Digital Research, Inc. These CP/M software packages, in addition to all the features that standard CP/M incorporates, includes low resolution graphics commands such as GR, COLOR, PLOT, VLIN, HLIN and SCRIN and high resolution commands such as HGR, HCOLOR, HPLOT as well as other statements that have been added from Applesoft such as TEXT, HTAB, VTAB, INVERSE, NORMAL, PDL. Other statements which have been added that implement well on the Apple include BUTTON, BEEP, HSCRIN, and VPOS.

WHAT IS THE PRIMARY DIFFERENCE BETWEEN THE Z-80 AND THE 6502?

The Z-80 is a register oriented processor whereas the 6502 is memory oriented. The Z-80 contains 18 eight bit registers and four 16 bit registers. Two accumulators and two flag registers are also provided. Moreover, all 8080 and 8085 assembly language programs will run unmodified on Z-80 systems because the 8080 and 8085 instruction code is a subset of the Z-80 instruction code. However, many instructions have been added eliminating the 8080's arithmetic and data processing shortcomings.

IN CASE OF DIFFICULTY

Should CP/M fail to boot using your Z-80 Plus, please check the following:

Make sure your software is good. Try your software in another Apple known to work with CP/M.

Modems, 80 column cards and other boards with a lot of firmware on them tend to confuse CP/M and ALL Z-80 cards. Try removing these cards first and then retry CP/M. Often, putting the Z-80 in slot 7 solves conflicts with other boards.

If you still have trouble, you may test the Z-80 Plus by putting it in another Apple, using a disk known to work. If the board still does not work, contact Applied Engineering.

The following is a list of the most likely fault in your system:

- 1) Bad software, disk is partially erased, or you have a 60K disk with a 48K apple.
- 2) Bad 16K RAM card (try trading with a friend).
- 3) Phase 0 is out of sync and/or weak data and address bus drivers on the Apple II+ (Ones sold between 6-82 and 2-83 are the worst).
- 4) The I.C. at location B2 (74LS245), B1 (74LS244) and B3 (74LS244) are bad or weak on the Apple IIe. (If you replace these I.C.'s do not use FAIRCHILD, MOTOROLA or T.I. Use MITSUBISHI or NATIONAL). Remember Apple buys its I.C.'s from the lowest bidder.
- 5) Disk drive is not running at the proper speed.
- 6) Bad Z-80 Plus card. Very unlikely, each card is tested in three Apples (two II+'s and one IIe).

For Further Reading:

The CP/M Handbook by Rodney Zaks *
Published by Sybex Inc.
2344 6th Street, Dept. A
Berkeley, California 94710
1-800-227-2346

Introduction to Wordstar by Arthur Naiman *
Published by Sybex
2344 6th Street, Dept. A
Berkeley, California 94710
1-800-227-2346

Microsoft BASIC *

Published by Dilithium Press
11000 S.W. 11th Street Suite E
Beaverton, OR 97005
(503) 646-2713

Programming the Z-80 by Rodney Zaks
Published by Sybex Inc.
2344 6th Street, Dept A
Berkeley, California 94710

How to Get Started With CP/M by Carl Townsend
Published by Dilithium Press
P. O. Box 606
Beaverton, Oregon 97005

CP/M Assembly Language Programming by Ken Barbier
Published by Prentice-Hall, Inc.
Englewood Cliffs, New Jersey 07632

Z-80 Programming and Interfacing
Published by Howard Sams, Inc.
4300 West 62nd Street
Indianapolis, Indiana 46268

* Most recommended

Criticism of this manual is welcome at all times. Welcomed are any comments which will enhance the content or format. Correspondence regarding this document should be addressed to:

APPLIED ENGINEERING

P. O. BOX 470301

DALLAS, TEXAS 75247